

**ENGINEERS AUSTRALIA
Western Australia Division**



**ENGINEERS
AUSTRALIA**

**NOMINATION OF
PERTH'S CAUSEWAY BRIDGES
FOR AN
ENGINEERING HERITAGE AUSTRALIA HERITAGE RECOGNITION AWARD**



Formwork and reinforcing steel being placed for concrete deck

PREPARED BY ENGINEERING HERITAGE WESTERN AUSTRALIA

ENGINEERS AUSTRALIA

WESTERN AUSTRALIA DIVISION

August 2012

CONTENTS

INTRODUCTION	3
STATEMENT OF SIGNIFICANCE	4
HERITAGE RECOGNITION NOMINATION FORM.....	5
OWNER’S LETTER OF AGREEMENT	6
HISTORICAL SUMMARY	7
BASIC DATA	9
DESCRIPTION OF THE PROJECT	11
EMINENT PERSONS ASSOCIATED WITH THE PROJECT	14
HERITAGE ASSESSMENT	21
INTERPRETATION PLAN	23
ACKNOWLEDGMENTS	24
REFERENCES	24
APPENDIX A – PHOTOGRAPHS	25

1. INTRODUCTION

When Western Australia's first governor Captain James Stirling established the Swan River colony in 1829 he founded two initial townships, the port settlement of Fremantle, on the south bank of the river, and an administrative capital upstream on the north bank of the river, below Mt Eliza, which he named Perth.

As a consequence of these perhaps hasty decisions the river was for some years the only real 'highway' for the movement of passengers and goods between Fremantle and Perth. The obvious place for a bridge to facilitate road traffic between the two townships was at North Fremantle, but the colony did not have the technical and financial resources to build a bridge there for at least 20 years. Travellers by road from Fremantle to Perth had to follow the south bank of the river to the location where Canning Bridge now stands, use a slow and expensive ferry crossing, then continue overland to a location approximating to the east end of the existing Causeway bridges, then traverse a series of mud flats to firm ground at East Perth.

In February 1831 the colony's Civil Engineer, Henry Reveley, was requested by Governor Stirling to "*remove the inconvenience of the Flats*" to allow boats to travel upstream. Various attempts were made to dig canals through the flats but it was 1840 before a successful canal was constructed. As a consequence over the period 1840 to 1843 two wooden bridges and earth embankments were constructed over the canal and mud flats to finally complete the crossing of the Swan River at the Causeway location.

The first Canning bridge was completed in 1849 allowing complete roadway access from Fremantle to Perth along the south bank of the Swan River. A high level bridge over the river at North Fremantle, built by the Royal Engineers using convict labour, was open to traffic in November 1866, permitting road access between the two townships by the more direct route following the north bank of the river.

A second Causeway timber bridge crossing was completed in 1867 after the first bridge crossing was almost destroyed by major flooding in the river in June 1862.

The current Causeway bridges were constructed by the Main Roads Department, Western Australia between 1947 and 1952.

2. STATEMENT OF SIGNIFICANCE

The construction of Perth's Causeway Bridges between 1947 and 1952 was a highly significant undertaking in Western Australian road infrastructure.

The bridges were the third road crossing at the site originally known as the Perth Flats by early European settlers.

Main Roads WA adopted the composite steel and concrete construction method which had its Australian origins in Tasmania, and, despite severe shortages of materials and money in the early post-war years, successfully completed construction of the bridges. Moreover they introduced a construction refinement by jacking up the support girders before concreting, removing the jacks after the concrete had cured, which transferred compression into the concrete of the deck, thus controlling shrinkage cracking resulting from future heavy traffic loading.

The successful completion of the bridges was a significant technical achievement and a fitting tribute to long serving Main Roads Bridge Engineer, E.W.C. (Ernie) Godfrey, who had been in charge of the department's bridge section since his appointment in 1928.

3. HERITAGE RECOGNITION NOMINATION FORM

The Administrator
Engineering Heritage Australia
Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Name of Work : Perth's Causeway Bridges

The above work is nominated for a :

Engineering Heritage Recognition Award

Location, including address and map grid reference :

This nomination refers to the two bridges linking the Town of Victoria Park to Heirisson Island and to the City of Perth. Refer to Appendix A , Figure 17, Google Earth map


Latitude 31°57'54.98"S, Longitude 115°53'03.39"E

The Owner is Main Roads Western Australia, PO Box 6202 EAST PERTH WA 6892

The Owner has been advised of this nomination and a letter of support is included.

Access to site : The site is readily accessible by road or on foot.

Nominating Body : Engineering Heritage Western Australia, Engineers Australia, Western Australia Division


.....
Professor Mark Bush, Chair EHWA

Date 31/7/12



ABN: 50 860 676 021

Enquiries: Steve Potter on (08) 9323 4328
Our Ref: D12#173113
Your Ref:

16 July 2012

Mr Mark Bush
Chair Engineering Heritage WA
Engineers Australia WA Division
712 Murray Street
WEST PERTH WA 6005

ATTENTION: PROFESSOR MARK BUSH

Dear Mark

ENGINEERING HERITAGE RECOGNITION CAUSEWAY BRIDGES

Thank you for your letter on 11 June 2012 advising that Engineering Heritage WA (EHWA) would like to nominate Perth's Causeway Bridges for recognition by Engineering Heritage Australia under its engineering heritage recognition program.

Main Roads' supports this nomination.

In the event that the nomination is successful, Main Roads will assist EHWA with organising a small ceremony to recognise this achievement and commemorate the 60th Anniversary, on 19 September 2012.

Main Roads Director of Strategic Relationships, Mr Steve Potter would be happy to liaise with your committee member, Mr Don Young to assist with both the nomination and ceremony.

If you require any further information please contact Steve on (08) 9323 4328.

Yours faithfully

Menno Hennevel
MANAGING DIRECTOR
OF MAIN ROADS

16 JUL 2012

5. HISTORICAL SUMMARY

The two bridges which are the subject of the nomination are the third road crossing at the Causeway site.

First Causeway 1843

In February 1839 the General Road Trust resolved to erect what it called a 'bridge and causeway' across the flats, at an estimated cost of 1800 pounds. The plans seemed to have been prepared by Major Frederick Irwin, although they had also passed through the hands of Surveyor-General J S Roe and Superintendent of Public Works Henry Trigg, following earlier planning by the Colony's Civil Engineer Henry Reveley. In July 1840 the tender submitted by George Handcock for the completion of the first bridge over the eastern channel, for the sum of £449/10/- was accepted and the first pile driven on November 2, 1840, supervised by Henry Trigg. The contract was completed in July 1841 and was followed by the construction of the approaches at a cost of £360. In May 1842 the second series of contracts was let, one from John Crane of £385 for embankments connecting the bridges, and the other from Mews and Cox of £499 for the second bridge 'being one hundred yards in length'. This second bridge crossed the navigational channel approaching the 1839 canal and extended across part of Heirisson Island. The project was completed in May 1843 at a cost of £1,814/10/- . Refer Figure To help pay for the project the original causeway was a toll road, with charges ranging from 1d (for a person on foot) to 6d (for a horse drawn cart). Refer to Appendix A, Figure 1.

Second Causeway 1867

In June 1862 major flooding occurred in the region. The first causeway bridge and embankments were almost destroyed after being submerged under over two metres of water. The new causeway, designed by Richard Roach Jewell, and built by convict labour, was the original one rehabilitated, extended and raised by about a metre. The structure, consisting of three timber bridges, with a combined length of 490 m (1600 feet), was modified several times during its life. The official opening of the newly re-furbished causeway on 12 November 1867 was a memorable occasion. Governor Hampton drove "through avenues of flags and bunting" from Government House to the site. Military corps, a band, and a great crowd were present for the opening. After speeches by other dignitaries the Governor declared the new causeway open with the words:

"I, John Stephen Hampton, Governor in and over the Colony of Western Australia, do hereby declare this Perth Bridge and Causeway open for traffic."

The proceedings were then disrupted when a young man on horseback raced across the newly-opened bridge before the Governor's procession, after announcing to the crowd:

"I, John Stephen Maley, do declare that I will be the first to cross this Perth Bridge and Causeway"

Budget restraints encountered during the construction meant that the bridges were structurally under strength giving cause to several modifications during its life. In 1899 it was widened by the addition of a footpath, while in 1904 it had been strengthened and widened by an average of 2.85 m (9.4 feet). Increasingly heavier traffic loads exacerbated the problems. Between 1927 and 1930 several replacement schemes were considered but due to the world wide depression they were put on hold and, in 1933, as a stop gap measure, a 3m (10 feet) extension was constructed on the downstream side. Refer to Appendix A, Figures 2, 3 and 4.

Third Causeway 1952

Following the establishment of the Main Roads Department of Western Australia in 1926 the upgrade of the existing Causeway became an important matter. Serious planning for replacement bridges continued during the 1930s. In this period considerable work was done to dredge the river channels to provide much wider navigation channels. Refer to Appendix A, Figure 5. It was recognised by 1940 that the existing bridges had to be replaced but shortages of construction materials due to the Second World War resulted in more major repairs being carried out in 1943 to make the bridges safe for at least another five years.

The bridges which were built in the period 1947-1952 were the first truly modern bridges built in Western Australia following World War 2.

The eastern bridge was the first to be completed, and was opened to traffic in September 1952, with traffic continuing to use the other two bridges of the previous causeway until the western bridge was completed.

6. BASIC DATA

Project name: Perth's Causeway Bridges

Owner: Main Roads Western Australia

Location: Linking Victoria Park to the City of Perth by crossing two channels of the Swan River via Heirisson Island. Latitude 31°57'54.98" S, Longitude 115°53'03.39" E

State: Western Australia

Local Government Areas: City of Perth and Town of Victoria Park

Designer: Main Roads Department of Western Australia

Year Commenced: 1947

Year Completed: 1952

Constructor: Main Roads WA bridge construction crews, supervised by Main Roads engineers

Physical Description:

There are two bridges at the Causeway site, MRWA asset nos. 914 and 932. The eastern bridge is 221 m (725 feet) long and the western one 115m (376 feet) long. The longer bridge consists of eleven 18.6m(61 feet) spans and a relieving span of 8.2m (27 feet) at each end. The shorter bridge at the western end has five 18.9 m (62 feet) spans and relieving spans of 10m (27 feet) at each end, a total length of 114.5m (375 feet). Provision was made for three vehicle lanes totalling 8.2 m (27 feet) in each direction and pedestrian footways on each side. Accommodation for all services such as water and gas mains was provided under the deck. The piers are reinforced concrete supported on timber piles and the abutments are reinforced concrete supported on reinforced concrete piles. The bridges have a composite steel plate girder/ reinforced concrete superstructure. There are nine simply supported 1.22m (4 feet) deep plate girders in each span.

Physical Condition:

The structures are in good physical condition although in 2004 localised concrete cracking in the piers due to the variable cement quality available at the time of construction in the early post war years required repairs which were successfully completed. The repairs were covered with a moisture-resisting coating.

Heritage Listings:

The bridges were permanently listed on the Heritage Council of Western Australia Register of Heritage Places on 30 October 1998. The National Trust Australia (WA) classified the bridges on 8 June 1998, Classification No. PER301.

7. DESCRIPTION OF THE PROJECT

In September 1944, Main Roads WA Bridge Engineer E. W.C. (Ernie) Godfrey (who had been appointed in 1928), submitted a proposal to Commissioner J.W. Young to build two new bridges upstream of the existing ones with a deck 19 metres (62 feet) wide, allowing for one tram lane, two vehicle lanes in each direction, a 2.4 m (8 feet) pedestrian footway on the downstream side and a narrow 0.7m (2.25 feet) footway on the upstream side. Refer to Appendix A, Figure 6. The combined length of the bridges was to be 341m (1119 feet). Timber piles were to be used and the deck was to be of composite steel and concrete construction. This method of construction had been pioneered in the 1930s by Mr Alan Knight, Chief Engineer of the Public Works Department of Tasmania. It involved tying steel support beams to the concrete deck with steel stirrups welded to the top flanges of the beams. In order to have sufficiently high clearances over river channels at high tide, the bridges were to have graded approaches and the roadway surfaces follow vertical curves. The drawing below is taken from a paper delivered by E. W. C. Godfrey to a Conference of The Institution of Engineers, Australia, in Perth in 1949.

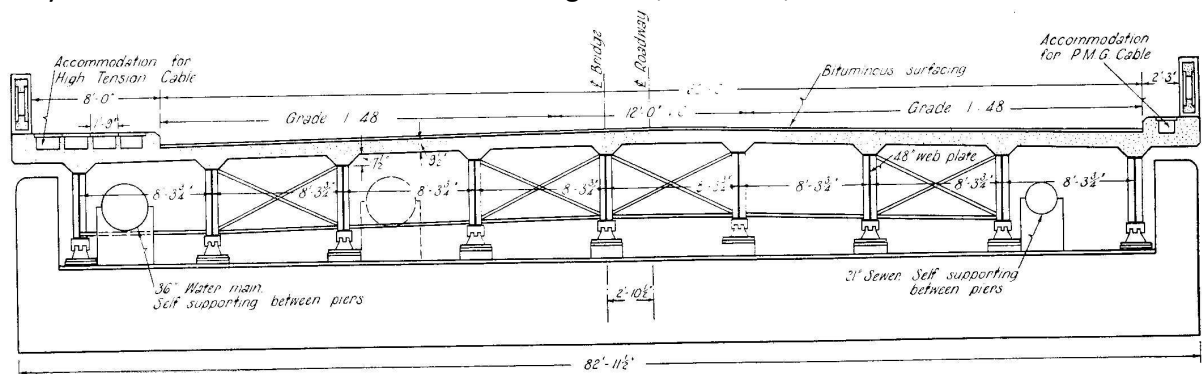


Fig. 2.—Cross Section of Superstructure.

The Institution of Engineers, Australia.

Although the design concept as detailed above was adopted in 1944, with minor changes, wartime shortages of money, materials and manpower delayed commencement of construction until May 1947. Postwar shortages of materials continued to delay the project. Vital supplies of cement were double ordered to try and ensure timely deliveries. As well as the local supplier, Swan Cement, supplies of cement came from England, Sweden, Poland, and Japan.

The construction workforce consisted mainly of Main Roads employees, supervised by Main Roads engineers.

The piers were constructed within coffer dams the perimeter of which consisted of birdsmouth karri sheeting planks driven by a barge mounted piling frame. Another piling frame was then supported on the coffer dams to drive the timber pier support piles. Refer to Appendix A Figure 7. Considerable foundation investigation work was done and sophisticated pile design techniques were used to model behavior of pile driven into soft material, this avoiding the settlement problems which had beset the first two Causeway structures.

A steam powered floating crane was used to lift the superstructure 1.22m (4 feet) deep plate girders into position. The girders were fabricated at the Welshpool factory of Forwood Downs Pty Ltd. It is worth noting that the late delivery of the steel for the girders was a prime cause of the delay in the project completion. Steel ordered from BHP for the girders in August 1948 was not delivered until the end of 1950. Refer to Appendix A, Figures 8 and 9.

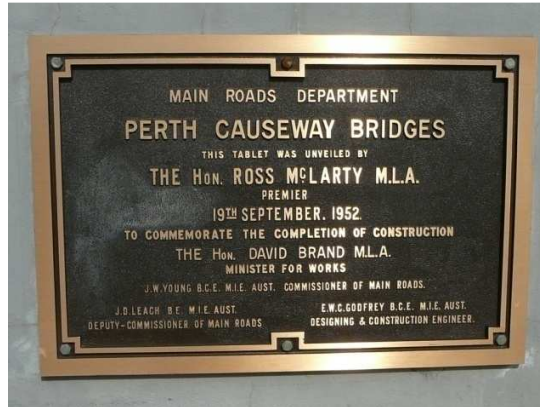
According to J.G. (Gilbert Marsh), who as a young engineer worked on the Causeway project (and succeeded Ernie Godfrey as Main Roads Bridge Engineer), the Causeway Bridges had a significant difference to the Eastern States composite concrete bridges in that the deck concrete was “prestressed”. This was achieved by securing the ends of the simply supported beams, and jacking up beneath the beams at the third points prior to casting the deck slab. When the concrete had cured the jacks were lowered, transferring compression into the concrete. Steel jacking trusses supported the jacks. This procedure prevented shrinkage cracking from developing into more serious cracking under heavy traffic loads. Main Roads subsequently used this technique on many North West Coastal Highway bridges. Refer to Appendix A Figure 10

15,000 metres (49,000 feet) of piles were driven to support the piers and abutments, 7300 cubic metres (9,500 cubic yards) of concrete and 508 tonnes (500 tons) of reinforcing steel used in the piers, abutments and deck.

Deck construction photographs are shown in Appendix A, Figures 11 and 12.

The final completed cost of the project was £1,752,000. Near to completion and completed photographs are shown in Appendix A, Figures 13 and 14.

The bridges were officially opened on September 19, 1952, with considerable fanfare, by the Premier, The Hon Sir Ross McLarty, MLA. He presided over a gathering of VIPs including The Hon David Brand, MLA, Minister for Works, The Right Hon. J Totterdell MLA, Lord Mayor of Perth, Mr J.W.Young, Commissioner of Main Roads, Mr J. D. Leach, Deputy Commissioner for Main Roads, Mr W. A. Mc. I. Green, Perth Town Clerk, Mr E.W.C. Godfrey, Designer and Construction Engineer and Mr C.S. Paterson, Perth City Engineer.



Plaque placed on Eastern Bridge after official opening

There is no doubt that the Government was genuinely impressed with the project. On September 26, 1952, the Minister for Works, the Hon. David Brand, wrote to the Deputy Commissioner of Works, Mr J Digby Leach, conveying his and the Government's appreciation of the efforts of Engineer Godfrey and his support staff. His letter included the words "having achieved a structure in the bridge building world which I feel will resound to the credit of Western Australia".

8. EMINENT PERSONS ASSOCAITED WITH THE PROJECT



Sir Ross McLarty



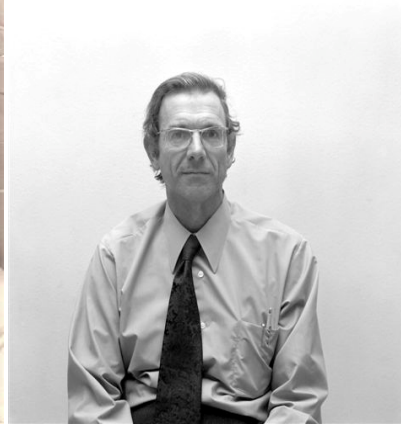
Mr J.W. Young



Mr J. D. Leach



Mr E.W.C. Godfrey



Mr J.G. Marsh

Sir Ross McLarty**(1891–1962)**

Sir Duncan Ross McLarty was born in Pinjarra in 1891 and came from pastoralist family in the area 85 km south of Perth. His father had been a member of the Legislative Council of the Western Australian Parliament.

He enlisted in the Australian Imperial Force in January 1916 and fought on the Western Front (from November 1916), winning the Military Medal in January 1918 *for bravery in the field*, at Passchendaele. Commissioned in May of that year he was promoted to lieutenant in August and wounded in action later that month in the Second Battle of the Somme. He was discharged in August 1919.

He entered the Legislative Assembly of the Western Australian Parliament in 1930 and became leader of the Liberal Party and the Opposition in December 1946. On 1 April 1947, as a result of a surprise election victory, he became the 17th Premier of Western Australia, heading a coalition of the Liberal party and the Country and Democratic League. During his six years as Premier extensive land areas were opened up for farming, the Kwinana industrial area was established, housing shortages were alleviated, and transport and power shortages were improved. He was knighted in January 1953 but lost the elections one month later. However he continued to lead the opposition until March 1957 and he resigned from Parliament due to ill health in May 1962. He died in December 1962.

J.W. (Jim) Young BCE, MIEAust

(1899–1962)

Commissioner, Main Roads Department, Western Australia, 1941-1953

Director of Works, Public Works Department, Western Australia, 1953-1962

James White Young was educated at Scotch College, Melbourne and Melbourne University, from where he graduated in civil engineering.

In March 1928 Young was appointed to the staff of the Main Roads Board of Western Australia and in the same year was made the first District Engineer of the Metropolitan District with responsibility for the construction of works by Main Roads in the district. In 1930 the Board's Chairman, Edward Tindale, was appointed the first Commissioner of Main Roads, a position he held until February 1941, when Young succeeded him. Young was Chairman of the Perth Division of the institution of Engineers, Australia, in 1938.

During World War 2 all major construction works were put under the control of the Allied Works Council. Although the Works Council set priorities the Main Roads Department was responsible for the construction of allocated works in Western Australia. These included the construction of a strategic unsealed road linking Western Australia with the eastern states. The Main Roads built the 730 km (450 miles) section from Norseman to Eucla. In addition Main Roads built forty seven airfields in the state between 1942 and 1944, including strategic ones in the north of the state, including Yanrey, near Onslow, Corunna Downs (in the Pilbara), Potshot (near Exmouth) and Noonkanbah (in the Kimberley). After the war Young was a member of the Commonwealth's post-war planning committee. He presided over the post-war reconstruction of the state road system and in February 1951 he was appointed Commissioner of Main Roads for a further five year term. Later that year he made a five month study and inspection trip to USA, and returned to WA with ideas about modern road making and trends and techniques he had observed while abroad.

Early in 1952 he was seconded to the Public Works Department as Deputy Director and, following the retirement of the Director, Russell Dumas, he was appointed to the top position.

On 18 January, 1953, handing over to his deputy, J D Leach.

J. D.(Digby) Leach

CBE, BE, FIEAust

(1897-1966)

Commissioner, Main Roads Department, Western Australia, 1953 – 1964

John Digby Leach was born at Yarm-on-Tees, Yorkshire, England on 25 November 1897. He was educated at Perth Modern School and the University of Western Australia. Before commencing his university course Leach served for more than three years with the 1st A.I.F 3rd Brigade Artillery. On completion of his studies he was awarded a BSc (Eng) degree in 1921 which was later upgraded to BE by examination and thesis (1935).

In 1923 Leach commenced duty with the Roads and Bridges Branch of the Public Works Department, Western Australia, and transferred to the Main Roads Board when it was formed in 1926.

After occupying positions of Location Engineer, District Engineer at Geraldton and Executive Engineer, Leach was appointed Deputy Commissioner in 1951 and Commissioner in 1953. In the post-war period Leach was closely identified with the innovative development of soil stabilisation techniques in which sands were mechanically stabilised using alluvial silts to produce stable pavements. Initially developed in the Geraldton region for land west of the Midland Railway, the techniques were extensively used in the Esperance Region and during the construction of the North–West Coastal highway.

During his terms as Deputy Commissioner and Commissioner Leach directed the rapid development of the Department's organisation to keep pace with the road demands resulting from the expansion of primary and secondary industries in Western Australia, including the implementation of the Stephenson Hepburn "Plan for the Metropolitan Region, Perth and Fremantle". Leach was Commissioner of Main Roads when Perth's landmark Narrows Bridge was constructed. He had the responsibility to ensure that the aesthetics of the magnificent site were maintained, and the Government was properly advised as to progress with the planning, design and construction of the bridge. Leach retired from the department in 1964 and in the same year he was awarded a CBE. He was Chairman of the Perth Division of the Institution of Engineers in 1950 and National President of the Institution in 1965. A major east–west highway in the Metropolitan Region, Leach Highway, was named in his honour.

E.W.C.(Ernie) Godfrey**(1892–1972)**

Ernie Godfrey was born in Murrumbeena, Victoria and graduated in civil engineering from Melbourne University.

He enlisted in the 3rd Division AIF in November 1915. He enlisted in the Australian Army in September 1940 and was assigned the rank of Captain. At the time of his discharge in October 1943 he had been posted to the HQ of the Royal Australian Engineers.

He joined the Main Roads Department of WA in 1928 and was appointed Bridge Engineer. Throughout his long career with the department he was responsible for the design and construction of many metropolitan and country road bridges, with the emphasis changing from timber structures to steel and reinforced concrete ones. These included pre-war metropolitan bridges such as the North Fremantle Traffic bridge (1939), the Garratt Road Bridge at Bayswater (1935), the Guildford Road Bridge at Guildford (1937), and the Canning Bridge at Applecross/Como (1938). From 1928 to 1953 predominantly steel and concrete road bridges were constructed over the Fortescue, Murchison, Gascoyne, Ashburton and Greenough rivers in the north of the state and over the Brunswick River at Brunswick Junction in the south west.

During World War 2 Godfrey was in charge of the Eucla end of the strategic interstate roadway from Norseman to South Australian border which Main Roads WA constructed on behalf of the Allied Works Council.

The culmination of Godfrey's career as a bridge designer came post-war with the design and construction of the composite steel and concrete Causeway Bridges details of which appear elsewhere in this nomination.

Godfrey reached retiring age in 1957 and was succeeded by his protégé Gilbert Marsh. However having overseen the preliminary planning for a major prestressed concrete bridge over the Swan River at the site known as the Narrows during 1954 –1954, and the selection of design consultants Maunsell and Partners (1954– 1955), he continued on as Liaison Engineer between the Department and the consultants for the currency of the construction contract for the bridge (1957 – 1959).

J. G. (Gilbert) Marsh

Born 22 November 1925

Graduating from the University of Western Australia in 1946 with a Bachelor of Engineering Gilbert Marsh joined the Main Roads Department WA as an engineer in the Bridges Branch, working under the direction of the Bridge Engineer, E. W. Godfrey. During this period he gained experience in most aspects of bridge investigation and design, and of bridge construction, using both direct labour and contract workforces. His most significant early project was the construction of the Causeway bridges, two steel and concrete composite bridges over the Swan River at the eastern approaches to Perth, between 1947 and 1952.

He was promoted to Assistant Bridge Engineer in 1954 and appointed Bridge Engineer in 1957. In 1954 government approval was given for the construction of a bridge over the Swan River at a location known as "The Narrows". He was responsible for the design and supervision of the reclamation work for the northern and southern approaches and liaison with the overseas consultants appointed to design the Narrows Bridge.

In 1961 Gilbert Marsh was awarded a Gledden Travelling Fellowship by the University of WA which enabled him to travel to the UK for twelve months, where he worked with consultants and contractors for six months and then undertook studies in soil mechanics at Imperial College, London, under Professor Sir Alec Skempton. His particular interest was in techniques which could be used for the rapid consolidation of the mud under the future Narrows Interchange.

During the 1960's the Main Roads commenced a programme of road construction, including freeways and arterial roads in the Perth Metropolitan area and the construction of a new National Highway across the northwest Pilbara and Kimberley regions. This involved the construction of many bridges and between 1962 and 1985 Marsh created and supervised a large professional organisation which undertook the investigation and design of the majority of the bridges built during this period. Marsh held the position of Bridge Engineer in Main Roads for 28 years, from 1957 up to his retirement in 1985.

In 1999 Gilbert Marsh was awarded the Engineers Australia John Connell Gold Medal. This medal is awarded to a structural engineer, widely recognised as holding eminent standing within the profession, who, inter alia, has made a significant contribution, preferably nationally and internationally, to the standing and prestige of the structural engineering profession.

9. HERITAGE ASSESSMENT

Historical Significance

The Causeway bridges constructed between 1947 and 1952 constitute the third crossing of the narrow passage in the Swan River originally known as Perth Flats and represent over 100 years of bridge building endeavour at the location.

The Perth Flats were first encountered by European explorers in January 1697, when sailors from the ships commanded by the Dutch navigator, William Vlamingh, rowed up the river named 'Swan' by Vlamingh because of the prevalence of black swans. The French expedition under the command of Nicolas Baudin also explored the river in 1801 when sailors from the *Naturaliste* ventured up the river past the Causeway site and in so doing named the island at the centre of the Perth Flats after midshipman Francois Heirisson. Captain James Stirling in 1827, also had a problem in having to have his boats carried across the flats before exploring further upstream. The site also has historical associations with the Western Australia's first Civil Engineer, Henry Reveley, Surveyor General J. S. Roe, Superintendent of Works Henry Trigg, Major F.C. Irwin, who designed and modified the first Causeway crossing opened in 1843, Richard Roach Jewell, who designed the second Causeway. E.W.C. Godfrey, Main Roads Bridge Engineer 1928 – 1957, who designed the third Causeway, and J.G. Marsh, Main Roads Bridge Engineer 1957–1985.

Technical Achievement

The current Causeway bridges were the first bridges in Western Australia to utilise the composite steel and concrete design concept, following on the first Australian use in Tasmania. Bridge designer Ernie Godfrey introduced a significant refinement to the concept by securing the ends of the steel support girders and jacking up at the third points prior to concreting the deck, thus transferring compression into the concrete when the jacks were released after the concrete had cured. This had the benefit of preventing shrinkage cracking from developing into more serious cracking under heavy traffic loads.

Social

The causeway site represent a continuous point of crossing between the eastern and western shores of the Swan River, traditionally for Aboriginal people and then for European settlers. The crossing is an important road link in the history of Western Australia connecting Perth with the southern and eastern suburbs. The current Causeway bridges greatly improved traffic flow into and out of the Perth CBD and were part of the final reshaping of the Perth Flats and eastern

foreshore area. The bridges are highly valued by the community in providing a link for pedestrians, cyclists and vehicle transport and access to the adjacent landscaped recreational areas.

Rarity

The Causeway bridges were the first bridge structures constructed in Western Australia using the composite steel/concrete design concept. The 'prestressing' of the concrete deck to prevent shrinkage cracking from developing into more serious cracking under heavy traffic loads is possibly an Australian 'first'.

Representativeness

The Causeway Bridges are a fine example of the composite steel and concrete construction technique. Sixty years after completion they are still carrying traffic in excess of original design capacity.

Integrity/Intactness

The bridges are essentially intact although extensive work has been done at the rotary at the western end and flyover at the eastern end to improve traffic flows to and from the bridges.

10. INTERPRETATION PLAN

1. Main Roads WA 60TH Anniversary Ceremony

The Owner intends to organise a ceremony on Wednesday, September, 2012, to commemorate the 60th anniversary of the official opening of the Causeway Bridges.

The intention is, subject to this nomination being successful, to 'unveil' an Engineers Australia 300 mm diameter disk. This would be fixed to one of the bridges at a later date, probably next to the bronze plaque which was installed after the official opening.

It also has been agreed with the Owner that Engineering Heritage WA will design and have manufactured an interpretation panel which will be installed at a location to be determined, probably close to a pedestrian/cycle path on the river bank, in sight of the eastern bridge. The timing of the installation of the panel will be late in 2012 or early in 2013.

2. Probable Themes of the Interpretation Panel 1200mm X 600mm

- Photographs and brief description of the first and second bridges erected at the site
- Photographs and more extensive description of the current bridges
- Photographs and brief profiles of the former Premier, Sir Ross McLarty and former Commissioners of Main Roads, J. W. Young and J. D. Leach.
- Photograph and more detailed profile of E.W.C. Godfrey, Main Roads Bridge Engineer and Causeway bridges designer

3. Panel Design

The panel will be similar to the one designed and manufactured for the Mitchell Freeway Stage 1 in 2011. See photograph below.



11. ACKNOWLEDGMENTS

The author wishes to thank the following people for their assistance in preparing this nomination.

Mr Lloyd Margetts, Engineering Heritage WA

Dr Richard Hartley, Engineering Heritage WA

Mr Gilbert Marsh, formerly Bridge Engineer Main Roads WA

Mr Steve Potter, Director of Strategic Relationships, Main Roads WA

Mr Arnold Godfrey, son of Mr E.W.C. Godfrey

Mr John Leach, son of Mr J.D. Leach

REFERENCES

The Vital Link, a History of Main Roads Western Australia, 1926–1990, by Leigh Edmonds

The Causeway Bridges–Swan River Perth, WA, Paper given by E.W.C. Godfrey BCE, to the Institution of Engineers Conference, Perth, WA, 1949

Perth Causeway 1830s to 1952, a Talk given by Lloyd Margetts on September 22, 2002

Swan and Canning Bridges, booklet prepared for 2009 Australian Engineering Week Tour by Engineering Heritage WA for Engineers Australia, WA Division (including a description of the design and construction of the current Causeway bridges prepared by Gilbert Marsh, supplemented by information provided by Lloyd Margetts)

Heritage Council of WA, Documentation for entry of Ballinyoo Bridge on HCWA Register of Heritage Places, March 2010. Ballinyoo Bridge was designed by E. W. C. Godfrey

Heritage Council of Western Australia , Permanent Entry of Perth's Causeway Bridges (1952) on Register of Heritage Places, 30 October, 1998

The Causeway, Wikipedia, July 2012

Crossing the River at the Causeway, Sue Graham–Taylor

Nomination prepared for Engineering Heritage Western Australia by Don Young, August 2012

APPENDIX A PHOTOGRAPHS

Figures 1 to 17



Figure 1, First Causeway, one of the two bridges, ca 1860



Figure 2, Second Causeway, one of the bridges, 1867



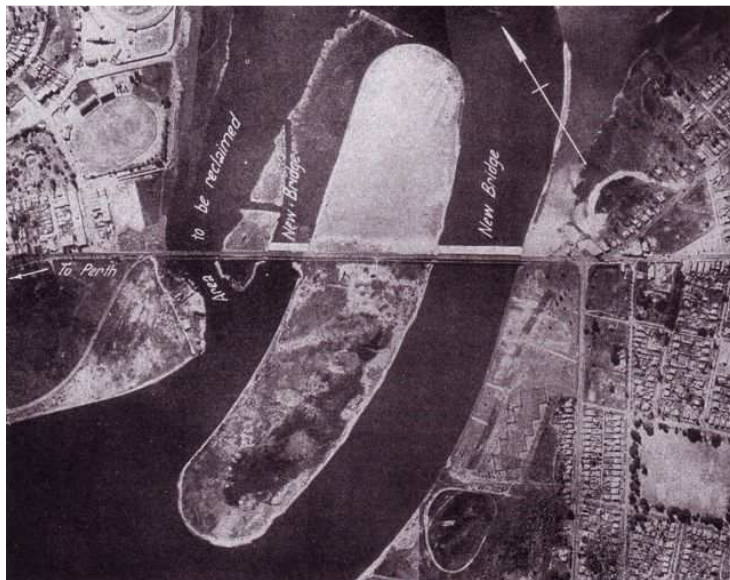
Figure 3,Tram crossing Causeway in 1906



Figure 4,Trams, buses, cars, horse and cart and cyclist sharing Causeway in 1920s



Heirisson Island 1935, showing dredging underway



Site plan of Causeway bridges, ca 1947

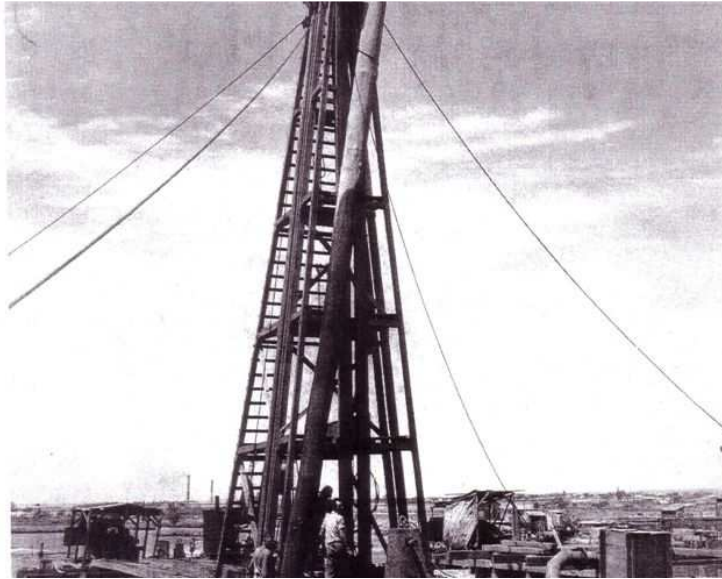


Figure 7, Timber pile being pitched before driving

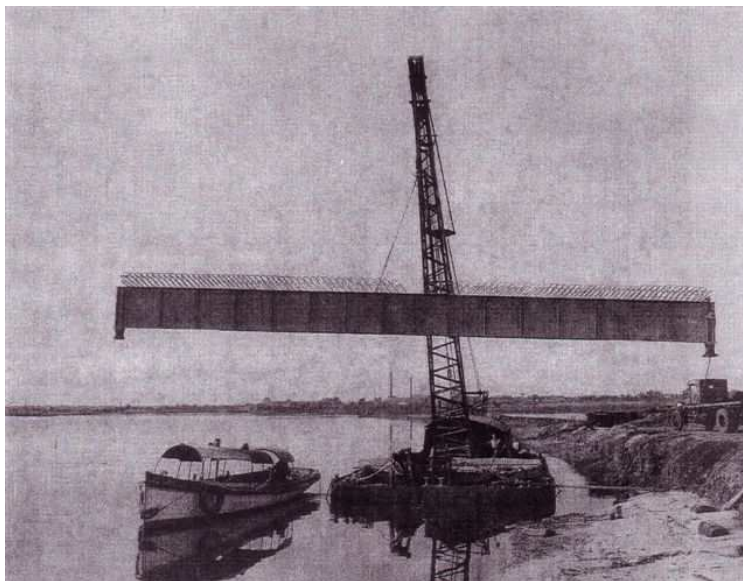


Figure 8, Plate girder being lifted from truck onto barge

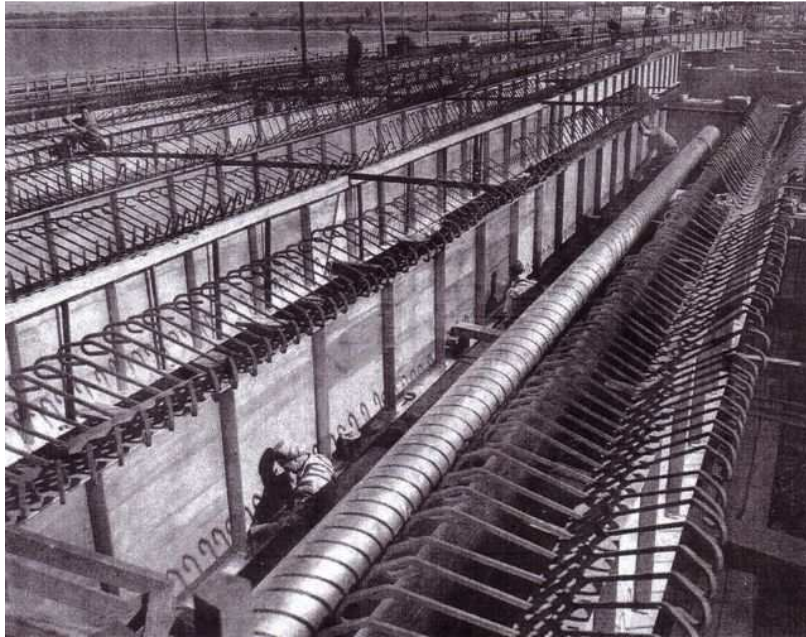


Figure 9, Formwork being placed for deck concrete

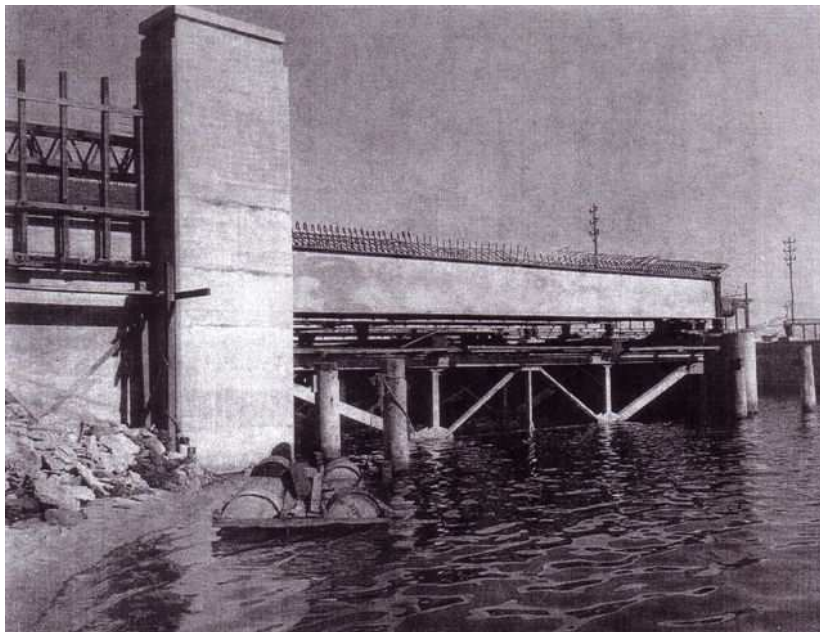


Figure 10, Jacking truss propping bridge girder in place



Figure 11, Completed piers, eastern bridge



Figure 12, Formwork and reinforcing steel being placed



Figure 13, Construction almost completed



Figure 14, Completed Causeway looking west



Figure 15, Eastern Causeway bridge, 2012



Figure 16, Western Causeway bridge, 2012



Figure 17 Google Earth Map of Perth Causeway July 2012